

The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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THE CHEMICAL AGE offices are closed on Saturdays in accordance with the adoption of the five-day week by Benn Brothers, Limited

VOL. XLIV. No. 1123

January 4, 1941

Annual Subscription, 21s.
Overseas, 26s.

Raw Materials of Warfare

THE chemist has to-day taken the place of the armourer when nations make them ready for war. The metallurgist, a specialised type of the genus *chemist*, is called upon to devise strange combinations of metals treated in cunning ways which shall have the most diverse properties. Some must be light, yet withal strong, others must be capable of resisting the death that flies in bullet or in shell, yet other metals are required for the weapons of destruction.

The chemist and the chemical industry of the country come even more directly into the picture in the manufacture of chemical substances required directly for war uses. Pre-eminent among these we like to think of drugs for healing the wounds and ills that war brings to suffering humanity. It is fresh in the minds of those who went through the last war how the dependence of the world on Germany for many chemicals caused a famine in fine chemicals. The price of aspirin, as an example, which was in the region of 6s. in 1914, had soared to 50s. in December, 1915, and was still 46s. six months later. By the end of the war home production had got into its stride and in March, 1918, the price was down to 13s., and in January, 1919, to 4s. To-day the initiative of the British chemical industry coupled with the operation of the Safeguarding of Industries Act has enabled us not only to be independent of European fine chemicals (and of many other chemicals also) but to export considerable quantities of these products, thus assisting the war effort in two ways. An official medical committee has been able to specify 70 drugs obtained from abroad as unnecessary in war-time medical practice in view of home-produced substitutes, some made synthetically and others obtained from home-grown herbs.

Synthetic phenols are another important contribution by the chemist to the raw materials of warfare. They are directly required in explosives production, and they are the basis of salicylic acid and a whole host of synthetic chemicals of importance in many directions. The only process used in 1914-18 was based on fusion of benzene sodium sulphonate with caustic soda. Alternative methods were introduced later, involving the decomposition of chlorobenzene, among which the Raschig continuous process may be specially mentioned. That the synthetic manufacture of phenol has been actively taken up in this country in the intervening years has been an important factor in the satisfactory position in regard to phenols and many other chemicals in which we find ourselves to-day.

Potash is another essential war chemical. Here we cannot claim to have any considerable home source of

supply. During the last war the production of potash from blast-furnace dust was investigated, and the discovery was made that the efficiency of dust removal from blast-furnace gases could be greatly improved, while in addition the yield of potash could be raised from 30 to 200 lb. per million cu. ft. of blast-furnace gas by addition of common salt to the charge. A plant suitable for refining the crude potash thus recovered was erected, and a venture on a considerable scale was about to be started by the Government and a chemical firm, when the war ended, and thereafter the price of potash fell to unremunerative levels. In those days we had as sources of potash only the deposits in Canada and Russia. To-day, the Dead Sea deposits have been developed, and the U.S.A. potash industry has assumed considerable magnitude. Inquiries are being made as to how far it is possible to replace potash by soda, consequent upon the cessation of imports from France which caused potash supplies to be officially controlled last August. Even for pharmaceutical chemicals it is contended that potassium salts are not always essential, and there was a movement in favour of educating medical opinion in this direction before the war. The salvage of bones is another aspect of this subject. It is believed by the Salvage Department of the Ministry of Supply that 25,000 tons of bones a year are wasted in dustbins, and that these could replace some of the bones we import from South America, Africa, the Middle East and India. From 100 tons of bones we get 12½ tons of bone grease, 12½ tons of glue, and 50 tons of fertiliser.

Glycerine is another important war chemical which, although controlled, is in much better supply than in 1914. It has been suggested that the use of the bombing aeroplane has reduced the demand for propellants, and thus for glycerine. This reasoning is probably fallacious, since the war will be won by armies at grips, and not by bombs. Nevertheless, the world supply has grown from about 135,000,000 tons in 1913 to 350,000,000 tons in 1939 largely because of the growing production and consumption of soap and because recovery of glycerine is now the rule in even the smallest soap-making and fat-splitting plants all over the world. A contributory cause has been the widening call for fatty acids and the utilisation for glycerine manufacture of new raw materials such as hydrogenated fish oils. In one way or another we are driven to the conclusion that since 1918 the chemists of the world have been helping to prepare for the present conflict, not perhaps consciously, but indirectly by making good whatever deficiencies were then apparent.

NOTES AND COMMENTS

Industry's Task in 1941

LIEUT.-COL. LORD DUDLEY GORDON, D.S.O., President of the Federation of British Industries, has addressed a New Year Message to British Industry. Brief and to the point, it well expresses the sanguine watchfulness which must be the actuating spirit of industry to-day. "During the closing days of 1940," he writes, "the attention of the whole world was drawn first to Lord Lothian's speech delivered for him by another immediately before his death in America and then to the statement on the war by the Prime Minister in the House of Commons. Both these pronouncements emphasised that 1941 must be the critical year for the British Empire and for the cause of freedom in the world. This coming crisis in 1941 can only be met by the successful endeavours of industry to supply the fighting forces, with which it is proud to be in partnership. The great industrial effort in the United States added to our own will ensure over-

note, in the descriptions of the 250th anniversary of *Berrow's Worcester Journal*, Britain's oldest surviving newspaper, that the journal actually kept for sale certain medicinal chemicals, to wit: "elixir for the dropsy, powder for the gout, Hypo drops, Royal Chemical Wash Ball, Dr. Egton's Balsamick," etc., etc. It is not known what the chemical industry of 1690 thought of this apparently unfair competition, but we can venture a guess at what the industry would say to-day if a newspaper announced itself as a supplier of chemical goods. We hasten to reassure our readers that *THE CHEMICAL AGE* will continue to restrict itself, so far as the selling side of the chemical industry is concerned, to furthering the efforts of genuine chemical manufacturers towards widening the field of sales for British chemicals.

Indian Industrial Expansion

INDIA'S industrial production during the year ended March 31, 1940, detailed reports of which have lately come to hand, has recorded an all-round expansion. The overseas demand created by the war, coupled with disloca-



LONDON CARRIES ON

The offices of "*The Chemical Age*" are in the tall building on the right of the picture, silhouetted against the glare of a great fire at the back.

whelming superiority by 1942, but it is industry in Great Britain which has to bear the strain and provide the main requirements of 1941. Industry will not fail to respond to this urgent call for redoubled efforts in spite of enemy attempts to terrorise and to destroy. To achieve our purpose there must be rigorous cutting down of unessential goods and services. At the same time, it is necessary to exercise the utmost care in planning in order that the man-power and productive resources thus released shall be quickly reabsorbed. In this effort, as in others, the Federation of British Industries has kept in consultation with the Government and will continue to give its active co-operation in order that dislocation and delay may be reduced to a minimum. I have no doubt that the coming year, stern and arduous as we may expect it to be, will lead us and the world to the success of our cause—freedom."

Selling Chemicals in 1690

NOWADAYS it is not the custom for newspapers to advertise themselves as purveyors of miscellaneous goods, certainly not of chemicals; but it is amusing to

tion of import trade, created fresh opportunities for marketing Indian industrial products successfully, with the result that some of the more important industries, including iron and steel, paper and heavy chemicals, received a big fillip. The industrial spurt was reflected in the big increase—as much as 10 per cent. over the previous year—in the consumption of power. For the heavy chemicals industry, several factories were under erection during the latter half of the period, so that a true indication of the expansion of this industry will only be provided during the current year. The production of sulphuric acid and sulphate of ammonia increased from 505,700 cwt. and 14,800 tons to 598,360 cwt. and 19,800 tons respectively. The indigenous supplies of aviation petrol represented a gain of 25 per cent. and amounted to 57,824 gallons, while that of motor spirit was up by 1,234,721 gallons to nearly 21,000,000 gallons. In the absence of adequate supplies of paper from abroad, the demand for indigenous production increased, and half a dozen companies were floated during the year to fill up the gap caused by the fall in imports. The production of paper increased by about 33 per cent. to 188,460 cwt.

OCTANE VALUES

The Testing and Evaluation of Motor Fuels

By V. BISKE, B.Sc.

THE term "octane value" indicates a method for evaluating fuels intended for spark-ignition engines, in terms of their knocking propensities. It was long known as a practical phenomenon, prior to a more scientific investigation, that, under certain conditions, engines would "knock," "pink" or "detonate." Before going any further, however, a definition of these terms is desirable. The manifestation under discussion is best referred to as "knocking." The term detonation is often used in this connection, but it also has a more special meaning in combustion technology and, while in certain circumstances the burning of a fuel under knock-producing conditions may cause detonation to occur, this is not necessarily always the case. The expression "pinking" is a colloquialism best omitted from a technical discussion. We should also mention here the term "pre-ignition" since it is sometimes used, incorrectly, to refer to true knock. Pre-ignition is quite a different phenomenon which occurs either when the charge is fired prior to the occurrence of the spark or else when the spark itself is set too soon and the charge is fired excessively early in the cycle so that maximum pressure has developed before the piston has reached top dead centre. Such pre-ignition, if not caused by a faulty time of the spark, is usually due to a hot particle of carbon or by an excessively hot portion of the sparking plug; it may well be, and often is, a consequence of knocking, but it should not be confused with the latter.

The scientific study of knocking and particularly the recognition of the fact that it is, primarily, a property of the fuel and not of the engine, goes back about twenty years; the pioneer work in this field was very largely carried out by Midgley in the U.S.A. and by Ricardo in this country. Since then a great deal of research has been carried out all over the world on the question of knocking, on how to prevent it, and on the characteristics of fuels that influence their knocking behaviour.

The Probable Cause of Knocking

Despite the enormous amount of work that has gone into the elucidation of the cause of knocking, agreement has by no means been completely reached. However, the most usually accepted explanation is, very briefly indeed, as follows: ordinary combustion proceeds at a relatively slow rate; on the other hand, the type of combustion that causes knocking goes on very much faster. As the combustion wave travels through the mixture in the cylinder it compresses and heats up the gases in its front. During this time there are going on, in this as yet unburnt part of the gas, a number of chemical reactions, probably of what is known as the chain type. These reactions continue up to a point at which they suddenly begin to multiply at a very rapid rate; that is, at this point, the gas starts to burn, not with the relatively slow rate of normal combustion, but with the much accelerated rate of combustion of the type that causes knock. This knock is due to the fact that this rapid type of combustion sets up waves in the mixture, which are reflected from the metal sides of the cylinder and from the piston, and, in being reflected, are also partially transmitted through them, causing the characteristic sound we know as "knocking."

As already mentioned, these reactions in the end-gas are probably chain reactions, and the most likely function of an anti-knock agent or knock inhibitor is to keep these chains short and thus, by preventing them from growing, to stop reactions from attaining the point where sudden multiplication of the number of chains occurs and at which rapid combustion of the type causing knocking begins.

Another factor in the causation of knock is the time for which the unburnt gases are exposed to heat and pressure. Therefore, the tendency to knock can be greatly influenced

by engine design. If the cylinder head is of the type that keeps cool by conducting heat rapidly away and in which the gases are kept in a state of turbulence, tendency to knock is greatly reduced. By proper attention to such points the efficiency of an engine can be raised by the equivalent of half a compression ratio as compared to an engine not as well designed yet running on the same fuel. Apart from the unpleasant noise, knocking in an engine is highly undesirable on account of the generation of excessive heat (thus leading to pre-ignition as mentioned above), loss of power, and damage to mechanical parts.

The Function of Molecular Structure

Investigations into the knocking properties of fuels have led to several conclusions of a generalised nature. In the case of hydrocarbon fuels knocking is closely related to chemical structure. Among aliphatic compounds it is found that the straight-chain paraffins are very knock-prone; as branching of the chain occurs, however, knocking diminishes with increasing compactness of the molecule. The presence of an unsaturated linkage (double bond) in the molecule also increases its anti-knock value, and the position of the double bond is an additional factor, being the more effective the nearer it is to the centre of the molecule. The result of ring closure (as in the case of the naphthenes) also has a favourable effect, although in the case of ring compounds the presence of side chains causes a marked modification. In the case of ring compounds with long side chains the effect of these latter can completely outweigh the influence of the ring.

When we come to consider hydrocarbons of the aromatic series we find that they occupy a high place in the list of fuels with low knocking characteristics. Here, again, the influence of the side-chain is of importance. It is interesting to note that in the case of side chains up to three carbon atoms in length (*i.e.* up to propyl) the influence is favourable, but after this number the anti-knock rating of the compound decreases. The introduction of methyl groups into the benzene nucleus has a particularly favourable effect, as can be seen in the case of xylene, toluene and mesitylene which are of increasing anti-knock value. When dealing with substituents in the benzene ring their position, *i.e.*, *ortho*, *meta* or *para*, is also of importance. In general when dealing with compounds of a homologous series the lower members are better rated than the higher. Thus methane and ethane possess particularly high octane numbers, although the higher normal paraffins are very poor in this respect. As a rule oxygen-containing fuels are of high octane rating, *e.g.*, ethyl alcohol and acetone, but there are important exceptions, for example, diethyl ether.

From both the theoretical and the practical points of view the information that has been gathered as to the knock-ratings of various types of fuel is of the greatest value. It is, however, not always possible to select one's fuel purely on its octane value since other considerations both technical (*e.g.*, volatility) and commercial (*i.e.* cost) are involved. For this reason it is necessary to utilise materials which are originally of a low octane value. In order to avoid the disadvantages that would ensue from such a course these low-grade fuels can be improved in various ways, which, in general, fall into one of the three following groups.

1. By altering their chemical structure so as to form from them hydrocarbons of higher value. Such methods include cracking, reforming, polymerisation, alkylation, etc.
2. By blending with fuels of higher octane value, such as benzol and alcohol.
3. By adding a substance that will inhibit knocking.

Methods falling under the first of these headings are of a

highly technical character and must remain outside the scope of this discussion. The second group is self-explanatory and we will, therefore, confine ourselves to dealing with methods falling into the third group. It must, however, be borne in mind that combinations of all these methods are usually employed in practice.

Many substances have been discovered which, on addition to a fuel in such quantities that they do not materially affect its composition (*i.e.*, they are themselves of no fuel value), affect the knocking characteristics very strongly in either a positive or a negative manner. The former, which are termed "pro-knocks," are of no practical interest for engines of the spark-ignition type, although they can cast a light on the mechanism of knocking and they are nowadays coming into prominence in connection with fuels for compression-ignition (Diesel) engines. Of all the substances investigated the only one to assume practical importance as an anti-knock is an organo-metallic compound, lead tetra-ethyl, $\text{Pb}(\text{C}_2\text{H}_5)_4$. This has a very strong knock-inhibiting action, as is shown in the following table, where its efficacy is contrasted with that of other substances whose use has been proposed for this purpose. In this table the compound aniline, with which a large amount of the earlier work was done, is taken as unity.

Substance.	Relative efficacy.
Lead tetra-ethyl	118
Iron penta-carbonyl	50
Nickel carbonyl	35
Aniline	1
Benzene	0.09

Apart from the lead compound the only other substance of the above which has been employed on a commercial scale was iron penta-carbonyl. This had a short-lived vogue, some years ago, in Germany. Apart, however, from its reduced efficacy when compared with lead tetra-ethyl the iron compound suffers from the disadvantage of being photo-sensitive and thus decomposing easily and of depositing iron oxide on the sparking plugs, with consequent engine troubles. Originally a similar trouble was liable to accompany the use of lead tetra-ethyl, owing to the deposition of lead oxide, but this has since been almost completely overcome by the admixture of lead tetra-ethyl with halogenated organic compounds, principally ethylene bromide, by means of which the lead is eliminated in the exhaust gases in the form of volatile lead halide. The question of the possible toxicity of leaded petrols or of the exhaust gases therefrom led to some misgivings in the early days, but tests showed that the concentrations used were too slight to cause any danger.

Ethylene Bromide

Lead tetra-ethyl is manufactured by the interaction of sodium-lead alloy with ethyl chloride. The enormous amount of bromine employed in the preparation of the ethylene bromide which, as mentioned above, is an important constituent of ethyl fluid, has led to remarkable developments in chemical engineering technique and the novel use of sea water as a source of the raw material. The composition of ethyl fluid, as added to petrol, varies slightly from time to time, but the usual content of lead tetra-ethyl is about 64 per cent., the remainder is made up of ethylene bromide, ethylene chloride and a small amount of red dye. The amount which is added to fuel varies with the characteristics of the unleaded petrol and the use to which the final product is to be put; the more ethyl fluid added, within limits, the higher the quality of the fuel; the quantity of fluid used is, however, very rarely in excess of 4 c.c. per gallon (*i.e.* approximately 1 part in 1000).

When we come to estimating the knocking propensities of a fuel, we find that unlike other characteristics of liquid fuels, this property cannot be determined by means of a chemical or physical test. Several such methods have in fact been proposed, but, although if the full history and origin of the sample under examination are known an approximation to its anti-knock rating can sometimes be made by an analytical procedure, such means have only a very limited application

and (particularly when it is question of a fuel containing a knock inhibitor) the only satisfactory and reliable method is an engine test. For this purpose special engines have been devised. These are of the single cylinder type fitted with a special cylinder head so that the compression can be varied while the engine is running. The first such engine was developed by Ricardo in 1921 and he expressed his results in the terms of the highest useful compression ratio (H.U.C.R.) at which the engine would operate on the particular fuel under examinations.

About 1927 the present octane scale was suggested and the "C.F.R." (Co-operative Fuel Research) engine came into being. This engine, which is the most widely employed type for fuel testing at the present, is a 600 c.c. O.H.V. single cylinder unit. The engine is coupled to an electric motor which fulfils the dual purpose of serving as a starter and of absorbing the power once the engine is running. In Ricardo's original engine the detection of knock was done by ear, but nowadays electrical methods are employed. A "bouncing pin" is fitted in the cylinder head and is so adjusted that the rise of pressure incident on normal fuel combustion leaves it unaffected, but the sudden extra pressure caused by knocking causes the pin to jump and to close momentarily an electrical contact. The closure of this contact sends a heating current through a coil of wire in proximity to which is placed a thermocouple across which is connected a milli-voltmeter. This latter instrument is known as the "knock-meter" and indicates its reading on a scale from 0 to 100. The numbers on this scale are purely arbitrary and have no real significance; their purpose is merely to serve as a guide so as to enable the engine to be adjusted to a reproducible intensity of knock.

Determining the Octane Rating

The method of operation is, very briefly, to observe the intensity of knock with the sample of fuel under examination and then to operate the engine with fuels of known octane values giving knock intensities slightly lower and slightly higher than that of the unknown sample. Then by simple interpolation over a narrow range the knock rating of the specimen is determined.

The "octane" scale employed is got by selecting two pure substances, capable of being used as engine fuels and having fairly close physical characteristics (*e.g.* volatility, etc.), but of widely varying anti-knock values. The substances in use for this purpose are the pure hydrocarbons, *n*-heptane which, as a straight-chain paraffin hydrocarbon, has a low anti-knock rating to which the value 0 has been assigned, and *iso*-octane (2-2-4-trimethyl-pentane) which, being a branch-chain paraffin, has a high anti-knock value and which is rated at 100. To show the enormous difference between the octane numbers of isomers it is of interest to mention that the rating of the straight-chain compound, *n*-octane, is 0.

The "octane number" of a fuel is defined as the percentage of *iso*-octane in a blend of *iso*-octane and *n*-heptane which, when tested in a C.F.R. engine under standard conditions, has the same-knock intensity as the fuel in question. The standardisation of the conditions of test is most important since it is essential that no variable factor, other than the fuel, be introduced into the test; otherwise, results would not be comparable.

Apart from the dimensions of the engine and method of operating, the main factors which are laid down are: the speed of the engine (900 r.p.m.), the throttle setting (maximum opening), the spark timing (automatically varied with the change in compression), the mixture strength (set for maximum knock), the mixture temperature (140° C.) and the temperature of the cooling water (100° C.). The data given here are applicable to the "Motor" method of testing by the C.F.R. engine. This method has been found, after long examination, to give the best average agreement between the rating of fuels on a laboratory engine and in actual cars on road tests. The average results of a large number of road tests agree reasonably well with laboratory methods of

evaluation by the "Motor" method mentioned above. Other methods of using the C.F.R. engine are recognised, such as for instance the "Research" and the "Aviation," employing variations in the engine speed and mixture temperature such as are required for special purposes. Other factors influencing the results of knock-rating tests are the atmospheric pressure, which if very different from the normal must be allowed for, and the humidity of the air. The latter factor can cause appreciable variations in results and for really accurate work an air-conditioned room is desirable. A standard humidity of 0.0135 lb. of water per lb. of dry air has been proposed for this purpose. When fuels containing appreciable proportions of benzene or of alcohol are tested special allowances have to be made, since these substances have an anomalous effect on the results of engine tests.

The octane scale is now over ten years old and its limitations are becoming apparent. When it was first put forward an octane number of 100 was a laboratory maximum which did not appear to be practicable for fuels produced on an industrial scale. Such progress has, however, been made in petroleum technology that fuels with octane values of well over 100 are now being produced commercially. The octane scale is not suitable for such high quality petrols since difficulties lie both in the actual operation of the engine at such high octane numbers and in the interpretation of the results since, on the present accepted standards, it is not possible to obtain a true reading above 100. The operational difficulties with the engine are chiefly due to the fact that it has to be run at the upper limit of its compression ratio range of from 4:1 to 10:1, and with such compressions it is difficult to avoid the normal combustion pressure from influencing the bouncing pin.

Various alternative methods have been suggested for the measurement of these high octane values, but they have not,

as yet, gained universal acceptance by the recognised standardising bodies. Such methods include the measurement of the temperature rise within the cylinder head in place of the knock, the use of benzene blends to give reference fuels having octane numbers in excess of 100 and the introduction of supercharging on to the C.F.R. engine. It is this last method which, for the moment, appears to be the most promising. The engine is supercharged and the ratio is taken between the boost which is required to cause knocking with the sample under test as compared to the boost required to cause the same knocking when the engine is operated on *iso*-octane. This method has the advantage, that, unlike the octane scale, it has no upper limit and that it approximates more closely to the conditions prevalent in aero-engines which, nowadays, are almost all supercharged. Another suggestion that has been made is to measure the pressure in the engine at which knocking occurs.

Nearly all the development work on high-octane fuels is in connection with aero-engines since it is here that the most immediate effects of increased power from the same sized engine are felt; for instance an increase of octane rating of from 73 to 100 yields a 25 per cent. increase in power from the same sized engine, provided, of course, that the compression has been raised so as to take full advantage of the higher grade of fuel.

Whilst at the moment all such high-octane fuels are reserved for aircraft it is certain that, eventually, car engines will be designed to take full advantage of these recent developments in petroleum technology and when 100 (or over) octane fuel is readily available from the roadside pumps we can look forward to amazing performance figures for vehicles fitted with supercharged high-compression engines of quite modest nominal h.p. rating.

Pure Amino Acids

Precipitation from Hydrolysed Maize Gluten

BY successively adjusting the pH of a hydrolysed protein solution to the isoelectric point of each of the amino acids present, the latter can be precipitated in the relatively pure forms. Successful exploitation of this principle depends upon careful control of a number of other factors, such as density of solutions and crystallising temperatures. Details of its application to the isolation of pure leucine (α -amino-*isocaproic* acid) and tyrosine (*p*-hydroxyphenyl- α aminopropionic acid) are published in B.P. 528,162 (Corn Products Refining Co., New York). A suitable raw material is destarched maize gluten which is hydrolysed by boiling with 20 per cent. hydrochloric acid. Humin substances are removed by evaporation and filtration. Caustic soda may be used in adjusting the pH to the desired points, the tyrosine being first precipitated at pH of 2.4 to 3.4, followed by the leucine at pH of 6 to 7. Yields of 15 lb. leucine and 2 lb. tyrosine per 100 lb. maize gluten have been secured by this process which may consequently serve for production of these two amino acids (particularly leucine) at relatively low prices. Previously of interest only to research chemists on account of their high cost, these amino acids may now merit the interest of manufacturers in a wider field.

THE DU PONT DE NEMOURS COMPANY has launched three new chemicals on the American market, mainly intended for use by motorists. The first of these is a liquid in a 6-oz. shaker-top container for removing the remains of insects from windscreen, paint, or chrome surfaces without injury to the surface. The second, "Dissolve," when diluted with paraffin or fuel oil, emulsifies and dissolves grease stains from garage floors and other cement surfaces as well as from parts and equipment. The third is a rust inhibitor which is added, after flushing, to the cooling system from a measured aluminium foil package with perforated top. It is claimed to be suitable for all motor car radiators, as well as for other industrial uses.

Canada's Mineral Resources

Dominion Minister's Confidence

IN an important contribution to the special Canadian supplement published last Monday by the *Financial News*, the Hon. T. A. Crerar, Dominion Minister of Mines and Resources, writes proudly and encouragingly of Canada's almost inexhaustible supplies of minerals, both metallic and non-metallic.

Canada's mineral industry, he says, "strengthened by a succession of outstanding achievements, is throwing its full weight behind the supreme effort of an Empire at war. Day and night in mine, quarry, smelter and refinery, Canadian workmen, in the full knowledge of the great importance of their task, are turning out in steadily increasing quantities the metals and minerals required in the manufacture of war materials."

A Highly Organised Industry

He points out that Canada is one of the world's leading producers of metals and minerals; in 1939 her mineral production reached a record total of \$473,000,000. Where she really excels, however, is in the extent and variety of the minerals she produces. She ranks first in the world in nickel, asbestos and platinum; either first or second in radium; second in zinc; third in gold, silver and copper; and fourth in lead. The list of minerals produced in commercial quantities shows some 23 metals and 20 non-metals. Attainment of such prominence in world mineral production indicates the highly organised condition of her mineral industry. Canada's production of minerals and metals may well be a determining factor in the Empire's war economy. Of the metals considered most essential for war purposes the Dominion produces copper, lead, zinc and nickel in refined form, for the use of several industries now almost entirely devoted to the manufacture of war equipment.

Bitumen Extraction from Coal*

A Study of Various Solvents

QUANTITY and quality of the bitumen, the material extracted from natural and artificial coals with solvents, determine the technical value of these fuels. Bitumen which distills off at higher temperatures without being strongly decomposed is the cause of sandy coke formation from certain bituminous coals. If decomposition of bitumen below its boiling point under formation of larger molecules takes place, then these compounds cement the residual coal particles (the insoluble organic parts of coals) together, and hard coke is obtained. In the following study different solvents were used for the extraction of different coals, in order to obtain insight into the nature of those coals and of the resulting residual coals, and to arrive at data concerning the extraction capacity of different bitumen solvents.

The coals were ground to 200 mesh and extracted as completely as possible with the following solvents: acetone, benzene, dioxane, acetophenone, acetophenone followed by extraction with benzophenone, tetrahydronaphthalene (above its boiling point under pressure), and benzophenone at different temperature and pressures. Twenty-five gm. of each coal quality were extracted during 24 hours at room temperature or at the boiling temperature of the solvent. The extracts were separated from the residual coal by filtration over porous glass filters, the residual coals were washed with acetone, and this solution was combined with the solution containing the chief amount of bitumen. The solvents were evaporated in vacuum. Repeated boiling with water was carried out to remove these amounts of solvent which, through the formation of molecular compounds (for instance between phenols and ketones) at their boiling temperature, cannot be eliminated from the residual coal. In this way the solvent can be removed completely. The bitumen was dried at room temperature over phosphorus pentoxide in vacuum. When benzophenone was used as a solvent, the adhering benzophenone was eliminated from the bitumen by extraction with benzene.

The extractions with acetone, benzene, and dioxane were carried out in a Soxhlet extractor. The extraction temperature, therefore, was somewhat below the boiling temperature of the solvents. The amount of extracted bitumen was determined by the weight of the extract and by the amount of residual coal. The figures obtained agreed within a difference of about 5 per cent.

The bitumens of artificial coals extracted below 100° C. were solid. At higher temperatures very viscous oils resulted. A small amount of cracking may have taken place.

Different solvents extract different components from natural coal. Extraction of Pittsburgh coal with benzophenone at 310° C. produces 12.6 per cent. bitumen. The remaining residual coal gives sandy coke. The same coal extracted with tetrahydronaphthalene under pressure at 300° C. yields 18.8 per cent. bitumen. In spite of the higher amount of extracted bitumen, the residual coal gives a hard coke. Polar solvents with partial valencies on their oxygen atoms (dioxane, acetone, acetophenone) have a selective affinity toward the phenolic components of bitumen. Those phenolic substances are responsible for the caking properties of coal. Less polar substances, such as tetrahydronaphthalene, extract more of the neutral substances of bitumen which have little to do with the caking properties of his bitumen.

Acetophenone is the best extracting solvent at normal pressure. Its use has the advantage that there is no combination with a hydrogenation effect as is the case with tetrahydronaphthalene at elevated temperature. Tetrahydronaphthalene, alone or with phenols, is now widely used in industry and in scientific research work as an extraction agent for bitumen. Acetophenone decomposes at its boiling point in the presence of coal, with the formation of a brownish liquid.

It shows its superiority over the low-boiling solvents (acetone, benzene, dioxane), over the higher boiling solvents (tetrahydronaphthalene at 250-300° C.) under pressure, and over benzophenone. It removes most of the phenolic components of the coals which are responsible for their caking qualities.

It is to be concluded that polar substances such as ketones preferably remove substances of phenolic character from natural and artificial bituminous coals. These phenolic substances are the cementing substances that bind together the residual coal particles during the coking process. Less polar substances (such as tetrahydronaphthalene and benzene) remove preferably neutral substances which evaporate without strong decomposition during the coking process. Therefore, the coking properties of coals by this extraction are not changed. Benzene is a poor extraction agent compared with acetophenone and tetrahydronaphthalene. Artificial carbohydrate coals give much more soluble bitumen-like materials after extraction with any of the used solvents compared with natural bituminous coals. Artificial cellulose coals produced in weak alkaline medium show more soluble bitumen than artificial cellulose coal produced in neutral or weak acid medium.

Lignin coals give very little soluble bitumen, probably because of the small amounts of carbohydrates that are difficult to separate from the isolated lignin. This is one more important reason for the contention that natural bituminous coals could not have been formed extensively from lignin.

Halogenated Butanes

New Methods of Preparation

A NEW method for the preparation of 1,4-dihalobutanes consists in the reaction of tetrahydrofuran (tetramethylene oxide) with a hydrohalogen acid in presence of a dehydrating agent. Details of the method are published in B.P. 528,691 (E.I. du Pont de Nemours). Sulphuric acid is a convenient dehydrating agent and a solution of the hydrohalogen acid (e.g. hydrochloric or hydrobromic acid) for the purpose of the reaction may be prepared by introducing sodium chloride or sodium bromide into sulphuric acid. 1,4-dichlorobutane is a good solvent for oils and fats, while it can serve as the starting point for production of butadiene synthetic rubber (as outlined in G.P. 365,160 of the I.G.). It is doubtful, however, whether the latter method can compete at present with other methods of butadiene manufacture since tetrahydrofuran is a comparatively expensive material. Methods for synthesising the latter substance developed in recent years include the cyclisation of 1,4-butyleneglycol (B.P. 508,548; I.G.); cyclohydrogenation of butyl succinate (U.S.P. 2,130,501; du Pont); and cyclisation of tetramethylene glycol (Strukov, *Amer. Chem. Abs.*, 1936, p. 1769). The 1,4-dihalobutanes are nevertheless materials of considerable interest for many other synthetic purposes.

Institution of Chemical Engineers

Officers and Council Members Nominated

THE Council of the Institution of Chemical Engineers has nominated for election the following honorary officers and members of the Council, to take the place of those who are retiring at the nineteenth annual corporate meeting in London on April 4: President, C. S. Garland; vice-presidents, H. W. Cremer, J. H. Dobson, J. McKillop, A. Parker; joint hon. secretaries, A. J. V. Underwood and M. B. Donald; hon. treasurer, F. A. Greene; members of council, J. A. Oriol, W. Russell, S. J. Tungay; associate-member of council, D. M. Newitt. Nominations from members must be received at the office of the Institution, 56 Victoria Street, London, S.W.1, not later than February 21.

* From an article by E. Berl and W. Koerber, Carnegie Institute of Technology, Pittsburgh, in *Ind. Eng. Chem.*, 1940, 32, 1605-7.

Personal Notes

MR. R. A. MCEWEN has been appointed the new president of the Ulster Chemists' Association.

MR. ALEXANDER MALCOLM RITCHIE, of Uddingston, has been appointed a director of Bairds and Scottish Steel, Ltd.

MR. PERCY LEVY, younger son of Mr. George Levy, vice-chairman of George Cohen Sons and Co., Ltd., has been granted a commission in the R.A.F.V.R.

MR. A. W. MACKNEY, of the Wood Chemistry Section of the Division of Forest Products (Australia) has resigned his position in order to join Australian Newsprint Mills, Ltd., Hobart.

PROFESSOR FRANK STUART ATKINSON has relinquished the Chair of Mining at the University of Leeds (which he has held since October, 1935), to take up the post of agent at Upton Colliery, near Pontefract, in succession to Mr. W. G. Grace, who has accepted another appointment.

MR. R. G. W. EADIE has been appointed Assistant Controller (Technical) of Tar Products to the Ministry of Mines. In order to facilitate his acceptance of the appointment, Glasgow Corporation has granted Mr. Eadie leave from his duties in the Corporation's Chemical Department.

MR. E. HEMINGWAY JONES, chief technical assistant to Derby Gas Light and Coke Co., has been appointed combustion engineer in charge of the fuel control department of a large iron and steel works in the West of England. He will take up his new position at the beginning of this month.

MR. PHILIP JACKSON, M.I.Mech.E., of the Chemical Defence Research Establishment, has been elected a Member of the Institution of Chemical Engineers. This announcement is made in the January bulletin of the Institution, which also records the election of twelve associate-members.

MAJOR E. R. Y. CUBITT, R.E., sometime assistant manager of the Contractors' Plant Department of George Cohen and Co., Ltd., has recently been promoted to his present rank. He was granted a commission as 2nd Lieutenant in October, 1939, and saw service at Dunkirk.

PROFESSOR ERNEST ORLANDO LAWRENCE, of the University of California, Berkeley, Calif., U.S.A., has been awarded the seventeenth Duddell Medal of the Physical Society for his invention and subsequent development of the cyclotron, the instrument that accelerates atoms to very high speeds without the use of very high voltages.

MR. N. J. BOOTH, A.I.C., lecturer in chemistry and fuel technology at the Chesterfield Technical College, has been awarded the degree of M.Tech.Sc. by the University of Manchester for a thesis dealing with the action of sulphur on coal. Mr. Booth is also external examiner in organic chemistry to the East Midland Educational Union, Nottingham, and to the Union of Educational Institutions, Birmingham.

DR. W. E. COHEN, officer-in-charge of the Wood Chemistry Section of the Division of Forest Products (Australia) has been awarded the Smith Memorial Medal by the Australian Chemical Institute. In their choice of the recipient of this award for 1940 the Chemical Institute have selected a chemist whose field of work, including as it does the investigation of the chemistry of wood and of pulp and paper, is very much related to that of the late H. G. Smith himself, who was one of the pioneers in the chemical investigation of Australia's natural products.

OBITUARY

MR. E. H. SHORTMAN, who has died at Bloxwich in his eighty-eighth year, was a pioneer of the spelter industry and an authority on the metal trades. He had had important business associations with Bloxwich for many years.

MR. JOSHUA RANSOM TAIT, for 36 years proprietor of Tait's Chemical Works, St. Helens, has died in his seventy-third year. Before he founded the business in 1900, Mr. Tait was partner in a chemical company on the north-east coast which closed during the last war.

MR. JAMES FERGUSON, chairman of Lane and Girvan, Ltd., ironfounders, Bonnybridge, a well-known figure in the Scottish light castings industry, has died at his residence, Woodlea House, Bonnybridge. He was a director also of the Cannerton Brick Company, Ltd., Banknock, and of James Anderson and Co., Ltd., fireclay manufacturers, Glenyards.

MR. HAROLD ERNEST COPP, of Sutton-on-Hull, who died recently at Harrogate, aged 68, was one of the many gas engineers who have done good service for the chemical industry. Appointed manager and engineer of the Potteries Station of the British Gas Light Co. in 1914, he was there responsible for the erection of one of the first plants for the production of benzol and toluol.

NEW YEAR HONOURS

DR. EDWARD VICTOR APPLETON, D.Sc., LL.D., F.R.S., Secretary of the Department of Scientific and Industrial Research, has been created K.C.B.

MR. GEORGE EDWIN BAILEY, M.I.Mech.E., managing director of Metropolitan-Vickers Electric Co., Ltd., has been awarded the C.B.E.

MR. REGINALD MURDIN DRAKE, Secretary of the Association of British Chemical Manufacturers; MR. ARTHUR MORTIMER, Secretary of the Wholesale Drug Trade Association, and MR. SUKUMAR BASU, I.C.S., Secretary of the Imperial College of Agricultural Research, have been awarded the O.B.E.

PROFESSOR WILLIAM LAWRENCE BRAGG, O.B.E., M.C., Cavendish Professor of Experimental Physics in the University of Cambridge; DR. JAMES WEIR FRENCH, D.Sc., chairman of Barr and Stroud, Ltd., scientific instrument makers; MR. ALLAN JOHN GRANT, J.P., managing director of Thomas Firth and John Brown, Ltd., steel manufacturers; PROFESSOR JOHN SEALY EDWARD TOWNSEND, F.R.S., Wykeham Professor of Physics in the University of Oxford; BT.-COL. RAM NATH CHOPRA, C.I.E., Professor of Pharmacology and Director, School of Tropical Medicine, Calcutta, and DR. SHANTI SARUP BHATNAGAR, O.B.E., D.Sc., Director of Industrial Development, Advisory Board of Scientific and Industrial Research, and lately Director of Lahore University Chemical Laboratories, have been created Knights Bachelor.

New Control Orders

Fertiliser Exports to Eire

THE Board of Trade has made the Export of Goods (Control) (No. 43) Order, 1940, which came into force on January 1. Under the terms of this Order it is prohibited to export to Eire, without licence from the Board of Trade, fertilisers, simple or compound, including mixed fertilisers and compound manures and fertilisers consisting of ammonium nitrate with other materials.

Renewal of K.I.D. Exemptions

The Treasury have made an Order under Section 10(5) of the Finance Act, 1936, renewing until June 30, 1941, the exemption from key industry duty of all articles at present exempt, except dial, chinoline, dinitro-orthocresol, ethyl orthoformate and metaldehyde. Copies of the Order, which is entitled the Safeguarding of Industries (Exemption) No. 16 Order, 1940 (S.R. & O. 1940, No. 2182), may be obtained from H.M. Stationery Office.

DRILLING FOR UNDERGROUND SULPHUR DEPOSITS in India has been proposed by the Board of Scientific and Industrial Research, according to the American Consulate, Calcutta. The director general of the Geological Survey has pointed out certain sections of the country where he suspects that sulphur exists and suggested a grant of 10,000 rupees for test drilling where investigations have already shown potential evidence of the presence of that mineral. Particular attention will be given to drilling in Baluchistan.

General News

THE NATIONAL SAFETY FIRST ASSOCIATION is to consider changing its title to "The Royal Society for the Prevention of Accidents," and a special meeting will be held on January 8 to consider the proposal.

IMPERIAL CHEMICAL INDUSTRIES, LIMITED, have once again issued their pocket "I.C.I. Diary," the 1941 edition of which is now in distribution. It is in two parts, one being the diary portion and the other containing useful chemical information and tables.

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS announce increases in the price of bromides, B.P., as follows: ammonium, 3s. 0½d. to 3s. 10d. per lb.; potassium, 2s. 9½d. to 3s. 4d. per lb.; sodium, 2s. 10½d. to 3s. 6d. per lb. Anhydrous sodium sulphite has also risen from £28 to £29 15s. per ton.

THE BOARD OF TRADE has published the Trading with the Enemy (Specified Persons) (Amendment) (No. 13) Order, 1940, which came into force on December 19, containing 266 additions to the "Black List" of traders in neutral countries with whom it is unlawful to have dealings of any kind.

THE USE OF CHEMICAL FERTILISERS is attacked by Mr. C. Alma Baker in his recently published volume "The Labouring Earth" (Heath Cranton, 10s. 6d.). He contends that the addition of such man-made materials to the soil checks the growth of soil life, and regards them in the light of dangerous intoxicants.

THE SECRETARY FOR PETROLEUM ANNOUNCES that it has been decided to introduce on January 24, a scheme to promote the use, as fuels for commercial motor vehicles, "of certain coal tar oils such as creosote and similar products (but excluding light oils such as motor spirit and benzole and heavy oils such as Diesel oil which are already in general use)."

THE ELUSIVE NATURE OF VITAMINS was the theme of an address entitled "Some nutritional problems of war and peace," which Mr. A. L. Bacharach gave at the December scientific meeting of the Pharmaceutical Society. He stated that there was great difficulty in laying down a model diet in actual terms of food because of the variation in the constituents.

THE NATIONAL SURVEY undertaken by the Ministry of Supply (Iron and Steel Control) to bring all available fixed and demolition scrap iron to the furnace for war purposes is now being extended to Lancashire and Yorkshire. Somerset and Glamorgan have already been dealt with, and Scotland, London and the four North of England counties are in process of survey.

TO ASSIST OWNERS OF FACTORIES or other business premises, the Board of Trade has issued a leaflet bringing together all the necessary information on how to obtain materials to repair or licences to rebuild plant damaged by enemy action. In view of the great need for economy in materials and labour, owners can expect to be allowed to carry out only "first aid" repairs unless they are engaged upon essential work. Copies of the leaflet may be obtained through Local Authorities, from the Regional Licensing Officers of the Ministry of Works and Buildings, or from the Regional Officers of the Ministry of Health.

BOARD OF TRADE RETURNS for November, 1940, show that imports of chemicals, drugs, dyes and colours into the United Kingdom were valued at £1,063,783, a decrease of £261,095 compared with November, 1939. Exports were valued at £1,425,089, a decrease of £735,368 on the previous November, while re-exports, at £22,899, showed a decrease of £4978. For the eleven months ended November 30, however, imports increased in value by £1,711,552 to £16,179,275; exports, at £26,150,334, showed an increase of £5,856,740, and re-exports increased by £137,229 to £571,105.

THE MINISTRY OF FOOD has notified local authorities that it is intended to hold two-day courses of instruction in various centres for those who would be called upon to deal with contaminated foodstuffs, should gas attacks be made on towns. Public analysts, gas identification officers, qualified chemists and members of the technical staff of food firms may apply for permission to attend the course, but priority will be given to the officers of the local authorities. Application to attend these courses from persons other than officers of local authorities should be sent to Dr. A. P. Platt, Ministry of Food, Neville House, Page Street, S.W.1, by January 10. Details of the schedule of dates may be obtained from the same address.

From Week to Week

THE GAS RESEARCH BOARD has just published its first Annual Report, which, owing to present abnormal circumstances and similar obvious reasons, differs somewhat in its form from that which, it is hoped, future Annual Reports will assume. Reports of investigations carried out are necessarily very brief, and details of results must be awaited until after the war. Members of the council have had to divert their attention to problems more pressing than the building up of a broader research organisation, but they can derive satisfaction from having been able to aid Government Departments in a time of national necessity.

Foreign News

ACCORDING TO A REPORT from Belgrade, the French-owned Bor copper mines—the biggest copper mines in Europe and the greatest industrial enterprise in Yugoslavia—are to pass into German hands.

AN EXTENSION OF PLANT by the American Magnesium Corporation, now being completed, will triple its output of magnesium alloys. The corporation already uses more than half the magnesium now produced by the Dow Chemical Company.

ACCORDING TO AN ANNOUNCEMENT made by the Norsk Aluminium Co., and published in the Continental press, the company is now using an aluminium ore obtained from the Sognefjord in place of the bauxite previously imported from France. No details are given concerning the new ore.

THE GOVERNMENT OF INDIA has included paper (excluding newsprint), pasteboard, and potassium and sodium bichromates and other chrome compounds, excluding barium, lead and zinc chromates, on the list of goods subject to import control, according to an announcement made on Friday last week.

THE IMPORT INTO the Union of South Africa or the Mandated Territory of South West Africa of any aluminium in the form of ingots, bars, pellets, strips, circles and extruded sections, sheets and foil, is prohibited by Government order, except under a permit issued by or on behalf of the Minister of Commerce and Industries.

AMONG ADDITIONAL ITEMS placed under the U.S.A. Export Licensing Regulations by a proclamation issued by President Roosevelt are cobalt, plastic moulding machines, presses, lubricating oil, bromide, ethylene, ethylene di-bromide, strontium metal and ores, abrasives and abrasive products containing emery, corundum, or garnet.

AN INQUIRY CARRIED OUT by the Warsaw Chamber of Commerce, quoted by the *Schweizerische Handelszeitung*, has shown that 41.1 per cent. of chemical plants working in Warsaw in 1938 were again working by the beginning of October, 1940. Of all factories in Warsaw, 15 per cent. were undamaged in the German invasion, while 20 per cent. were completely destroyed.

FOLLOWING THE RETURN of the general manager and a director of the Monsanto-Southern Cross Chemical Co. (Australia) from the United States, the company has now commenced production of phenacetin, salicylic acid and sodium salicylate. The company already manufactures acetyl salicylic acid, sodium acetate, glacial acetic acid, and methyl salicylate.

A NEW COMPANY, Harz G.m.b.H., was founded recently in Germany, with a capital of RM. 1,270,000, for working processes developed by the Phrix G.m.b.H., Hirschberg, to utilise pine trees for high-grade cellulose. The company plans to collaborate with the Deutsche Bergin A.G. für Holzhydrolyse, Heidelberg. The process in use is doubtless akin to those described in last week's issue of THE CHEMICAL AGE.

Forthcoming Events

AN AFTER-LUNCH ADDRESS WILL BE DELIVERED to the Fuel Luncheon Club on January 8, by Mr. H. G. Austin, of the Oil Well Supply Company, Ltd. Mr. Austin returned from Rumania about two months ago, and has an intimate knowledge of the present position of the oil industry, politically, economically and technically, which he will fully describe. The meeting is timed at 12.40 for 1.10 when all members must be seated at lunch. Mr. Austin will speak at 1.45 and the meeting will terminate at 2.15. The charge will be 5s. per head.

Metallurgical Section

January 4, 1941

WELDING METAL TO GLASS

New Process of Metallisation Perfected

FOR the first time in history a method has been perfected in Britain for welding metal to glass. The glass used is of a specially toughened type and the metals are aluminium and certain alloys containing a high percentage of aluminium.

This process is at present used for making electric heaters. These are made by spraying aluminium which is in the form of wire and is sprayed by means of a "Schoop" gun, in a zig-zag pattern, on to the specially heated glass. An electric current is then passed through the long conducting path so formed. This heats the aluminium pattern and so, by conduction, the glass. A heater is normally formed of two such plates mounted back to back in a framework, so that the live metallised strips are inside. This arrangement protects the user from shock. These "glass-heaters" have been tested over a long period and have emerged satisfactorily.

Another application of the process consists in soldering metal discs or bolts on to glass. Tests have shown that very great strength is obtained in such a joint. The metal sticks so firmly that any attempt to dislodge it breaks the glass before the joint between the metal and the glass.

"The soldering of metal to glass," said an official of Pilkington Brothers of St. Helens, who have brought out the process, "has been the dream of glass technologists for years. By combining the use of toughened glass and aluminium and having overcome the technical difficulties of spraying, the process is now a practical one. It is also possible to stick glass to glass by the same process. This enables glass parts to be made of sizes and shapes otherwise impracticable. It is difficult to describe in specific terms the various applications of the process and it is, of course, obvious that materials will not be available for general purposes until the end of the war. When that time arrives, it is expected that the process will be adapted for use in some form or other in a large number of industries."

Preparation of Glass

The glass must be carefully cleaned before toughening, as if for silvering, as any grease or dirt burnt into the glass is shown up by the mirror-like surface of the aluminium layer. Care must be taken to avoid handling the glass after cleaning as even the grease from the hand becomes apparent after spraying. After cleaning, the glass is toughened in the usual way. The toughened glass is then cleaned with a suitable solvent. This must be done immediately before the spraying process and the glass must not be touched with the hands after this until the spraying is completed. Of course, as the glass is toughened, all working and drilling must be done before the toughening.

Technique of Spraying

There is no need here to go into the details of the maintenance of the spraying gun and its structure and operation, as these are fully described in the maker's pamphlets ("The Metal Spraying Pistol: its Installation and Operation," issued by Metallisation, Ltd., Barclays Bank Chambers, Dudley, Worcester, and "Le Pistolet Métalliseur," issued by La Société Nouvelle de Métallisation, of 26 rue Clisson, Paris 13e). Briefly, the gun consists of a body in which is mounted an air turbine that drives the feed for the metal wire through gearing, and carries a triple nozzle, through the centre of which passes the wire and through the annular sur-

rounding nozzles of which pass fuel gas, oxygen and air. The wire is melted close to the end of the nozzle by the oxy-gas flame and the molten particles of the metal driven forward on to the glass by the air blast. The only metals so far found to stick satisfactorily to glass, by this method, are aluminium and aluminium-manganese alloys containing a high percentage of aluminium. To make these stick, the glass must be at a temperature of approximately 300° C. at the time of spraying.

Details of Procedure

The procedure for making a radiator is therefore as follows: the glass is carefully cleaned before and after toughening; it is then placed in the heating furnace and remains there for four to six minutes according to size. About half a minute before the glass is due to come out of the furnace the gun is lighted and the flame adjusted, and the speed of the wire and gas pressure made right. The glass is then lifted out of the furnace, using wooden grips to avoid marking it, placed on the desk and a template placed over it. The gun is then lifted from its stand and spraying started. It is essential that all the surface be covered before the temperature falls below 300° C. After the thin initial coating has been applied, the layer may be thickened up as required, as further metal will stick to the original layer, even after it has become cold. After getting the thickness of the layer of a radiator approximately right by eye, a resistance test is taken and individual strips thickened up to give uniformity and accuracy.

The final touching up cannot be done until the glass is cold, as, owing to the high temperature coefficient of sprayed aluminium, it must be done at a known uniform temperature. (Room temperature is sufficiently accurate). After the final touching up, the copper for the terminals is then sprayed on, and the terminals attached by soldering, using pure resin as a flux. No acid of any sort must be used, as this could produce a slow attack on the layer which might not be apparent for some time.

Spraying Parts to be Soldered

For spraying parts to be soldered, the preparation and cleaning are done exactly as for a radiator, and then the part is heated in the furnace. The part is then placed on a table or desk, the template, for masking the parts of the glass not to be metallised, held against it, and it is sprayed with aluminium to about twice the thickness of layer used for a radiator. A slightly smaller template is then applied and copper sprayed on thinly (this layer is about half the thickness of the aluminium layer). It is preferable for the coppering to be slightly smaller in area than the aluminium, leaving about 1/16 in. of aluminium visible all round, but this is not absolutely essential. If a large number of similar parts have to be done it is obviously more economical to spray all the aluminium first, and then do the coppering of the whole lot after. The soldering is done in the usual way by "tinning" the portions which are coppered and then sweating the parts together.

It is also possible to cast lead blocks or pads on to the coppered area, and these may be arranged with a brass screw cast into them, so that fittings may be attached by means of nuts. This casting is done by using a suitable steel mould

and pouring the molten lead into it again, taking care that the temperature is not excessive. The mould should be preheated to about 250° C. to prevent too rapid chilling of the lead.

The whole process is not difficult if carried out with scrupulous attention to detail. Any deviation from the correct procedure causes immediate difficulties, which are often not easy to diagnose.

The largest glass that can be treated in the existing furnace is 34½ in. by 30 in. The reflectivity of sprayed aluminium to white light is about 55 per cent. (varying from 52 to 58 per cent.). This may be compared with that of vacuum-

deposited aluminium, which is about 85 per cent. Some experiments were started in the use of sprayed metal for decorative purposes on glass, including "Vitrolite"; these were promising and might be pursued at a more opportune time.

The development of the use of alloys of higher resistance also makes possible the use of the method for making plate-warmers. Experiments were also made with the use of vacuum-deposited layers with sprayed terminals, but so far these have not been very successful. If they could be developed they might be useful for high frequency resistances, as well as for the more domestic uses.

South African Zinc Market

Sheet and Dust Used in the Cyanide Process

ZINC in the form of discs, sheets or dust is an essential commodity in the extraction of gold on the Witwatersrand, the world's largest gold-producing area. Before the war this came from various world sources, including the United Kingdom, the United States, Holland, and Belgium, but with the outbreak of hostilities and the unprecedented demand for zinc for war purposes, normal supplies have been interrupted. Owing to the necessity for maintaining Empire gold production at its maximum, some concern has developed, therefore, lest existing sources of supply be further interrupted.

As Canada is one of the major zinc producers, the gold mines in South Africa have naturally turned to the Dominion in the hope of obtaining supplies there, and this move has been encouraged by the general desire to make purchases as far as possible within the Empire and thus assist in conserving foreign exchange. Unfortunately, up to the present neither zinc sheets nor zinc dust of the required specification appears to be produced in Canada. Canadian manufacturers with suitable facilities are, however, being encouraged to avail themselves of the opportunity of examining the situation.

Consumption of Zinc Sheet

Originally the electric precipitation method was used for gold extraction on the Rand, but it has been displaced by the cyanide process which is now exclusively used. Both the principal methods followed in the cyanide process use zinc as the reagent. In one case zinc shavings are used, these being manufactured locally from imported zinc discs or sheets. The use of sheets for this purpose is the more popular for reasons of efficiency, although discs are still used for the production of shavings in some of the older plants. The actual consumption of zinc sheets and discs by the leading gold mines of the Transvaal during the past three years was as follows: 1939, 3,005,583 lb. valued at £43,669; 1938, 3,280,938 lb. at £50,839; 1937, 3,694,338 lb. at £47,591.

It will be observed that the consumption has decreased steadily since 1937. This is accounted for principally by the trend to the latest method of gold extraction by the Crow-Merrill process, which requires the use of zinc dust rather than shavings. All new plant being installed, or old plant being replaced, now employ the latest method. Nevertheless, the demand for zinc sheets is still very important and is likely to be so for some considerable time to come.

The standard requirement for zinc sheets is that they shall be 8 ft. long by 3 ft. wide by 12 gauge. It is essential that the sheets be exactly 3 ft. wide to fit the shaving machines; but a length of 8 ft. is not strictly important, variations from 5 ft. to 8 ft. being permitted. The composition of the zinc is also important. The best sheets are 98 per cent. pure zinc with 2 per cent. lead. Under existing conditions, zinc sheets are now being rolled by the Steel Corporation in South Africa from zinc produced at the Broken Hill mine in Northern Rhodesia. This is an entirely new development brought

about by the war. While the sheets thus produced are proving generally satisfactory, they are being made from electrolytic zinc, which is over 99 per cent. pure. It is generally thought that the practical absence of lead retards the gold extraction process, and consequently it is desirable that the zinc should be only 98 per cent. pure and the balance lead. Notwithstanding this belief, the pure zinc is understood to be giving satisfactory results.

Increasing Use of Zinc Dust

The actual consumption of zinc dust by gold mines in the Transvaal during the past three years was as follows: 1939, 2,250,018 lb. valued at £51,136; 1938, 1,886,898 lb. at £45,261; 1937, 1,401,796 lb. at £38,494. As the zinc dust required for this purpose is used for an exact process, it follows that the specifications are rather rigid. These have been generally laid down as follows: The dust must be guaranteed to contain 95 per cent. uncombined metallic zinc, and not less than 3 per cent. lead. It must pass a 325 screen with a residue of not more than 4 per cent., and must be perfectly free from flakes.

Zinc dust is at present imported chiefly from the United States. But from whatever source, it is desired that packing be in heavy-grade steel air-tight drums, encased in plywood. The drums should contain 100 pounds net weight of zinc dust, and the containers must be of ample strength to withstand rough handling in transit.

Japanese Iron and Steel

Self-Sufficiency Plan

ACCORDING to a Reuter message from Tokio, a revised plan for "making the Japanese iron and steel industry completely independent of foreign scrap-iron and steel" has been announced by Mr. Maoki Hoshino, Minister without Portfolio and President of the National Planning Board, after a Cabinet meeting which approved the scheme. It provides for increased production of iron and steel and of coal suitable for iron manufacture.

Japan, Mr. Hoshino said, was now in a position to carry out this "epoch-making reform." Stocks of various materials had been accumulated in anticipation of the present stoppage of the import of scrap-iron from abroad.

ACCORDING to LOCAL PRESS REPORTS, an important American concern has contracted for the purchase of 100,000 tons of Brazilian bauxite, to be delivered from January onwards. It is also stated that the U.S. Reconstruction and Finance Corporation will lend the buyers \$15,000,000 to build an aluminium factory in the U.S.A. The purchaser is stated to be the Reynolds Metal Company, while the contract has been signed with the Companhia Geral de Minas. Purchases will be increased to 180,000 tons by 1942, although they may be expanded earlier if the company can develop its new plant to handle the ore.

Alloys for Corrosive Services

Patented Austenitic Iron for the Chemical Industries

THE term "Austenite" refers to a certain physical condition in which a metal can exist, *i.e.*, the austenitic state, and ordinary cast iron assumes this condition only after prolonged heating at temperatures above 800° C. At such temperatures the atoms comprising the crystals of cast iron take up a certain orientation or "positioning." Except for traces of sulphide crystals or slag particles, all the constituents of the metal, including iron carbide, are then in a state of solid solution and the metal is therefore in a completely homogeneous condition. Subsequent cooling of cast iron, however, destroys the austenitic state; owing to its unstable nature the iron carbide is thrown out of solution, and the metal reverts to its original and normal pearlitic structure. Austenite appears structureless under the microscope except when so deeply etched as to show grain boundaries.

The introduction of various alloying metals has a remarkable effect upon cast iron, for by this means the temperature at which the austenitic state is produced can be brought considerably lower than 800° C. and, what is more important, the resulting alloy retains the homogenous austenite state, even at normal room temperature. Alloys rendered austenitic in the manner aforementioned possess a number of surprising properties. Chief among these are corrosion-resistance to a variety of liquids and gases that attack ordinary cast iron and also resistance to scaling and growth due to heat.

The patented alloy, Audcoloy, produced by the Audley Engineering Co., Ltd., of Newport, Shropshire, belongs to the aforementioned group of austenitic cast irons. It differs essentially, however, from all other proprietary alloys of this classification in several qualities of structure, composition and characteristics. It exhibits the corrosion-resistance of its group towards a great variety of acids, alkalis, gases and industrial liquors, and in some instances such as sulphuric acid, caustic soda, and highly sulphurous fuel oils at elevated temperatures, to a very remarkable degree.

Certain metals when added to cast iron are found to produce alloys that retain the austenitic state at ordinary temperatures. Among these are manganese, copper, nickel with chromium, etc. Early experimenters used manganese or manganese with nickel; but the alloying elements now generally employed are nickel and copper together. Audcoloy contains an excess of both nickel and copper in order to ensure the maintenance of austenite under all conditions.

The corrosion and erosion-resisting properties of high (15 per cent.) silicon irons are well known. They find indus-

trial applications where mechanical weakness and high cost have not to be taken into account; but for many purposes their brittleness, absolute unmachinability and susceptibility to cracking under the influence of sudden temperature changes render ordinary high silicon irons impracticable.

In addition to nickel, copper and small quantities of other essential metals, Audcoloy contains a sufficient percentage of silicon to impart to it increased resistance to erosion, but

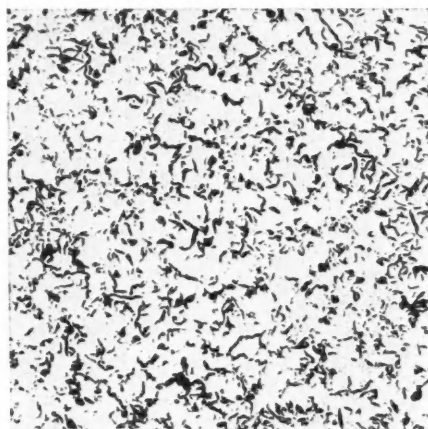


Fig. 2. Audcoloy $\times 60$ unetched, showing the evenly-distributed small flakes or nodular type of graphite

without making the alloy brittle, unmachinable or unsuitable for use at high temperatures. It thus combines most of the advantages of the two groups of alloy irons, austenitic and high silicon, and eliminates the disadvantages of the latter. By controlled adjustment of the silicon content, the physical properties of Audcoloy can be varied so as to meet a wide range of erosive services without any detriment to its corrosive resistance.

Martensite

Martensite is an extremely hard structural condition found in certain circumstances in cast iron and readily obtained by the addition of certain alloys, *e.g.*, 5 per cent. nickel. It is believed to be an initial precipitation of minute particles of iron carbide from the homogeneous solid solution of austenite along certain planes, sometimes appearing as tiny willow leaves under the microscope. It is produced in ordinary cast irons by drastic quenching from high temperatures and brittleness in the material results from this treatment. To suit heavily abrasive services an austenitic iron can be made martensitic by a much less drastic method to give a mixed structure of austenite and martensite that is both hard and tough. This hardness is obtained by reducing the nickel and copper content to a point at which austenite begins to break down to martensite. A reduction of the essential elements in this way produces the required degree of hardness, but is accompanied by an unavoidable loss in corrosion-resistance.

Martensitic alloys, though very hard, are amenable to heat treatment to facilitate machining. Rapid quenching at 900° C. (*i.e.*, well above the austenite-producing temperature) will bring the alloy to a softer condition, but care should be exercised during machining or work-hardening will result, whilst the alloy will also revert to its hard state when slowly cooled after re-heating to 900° C. Alloys containing martensite are strongly magnetic.

No single type of alloy can be made to suit all the conditions prevailing in industry, but the composition of Audcoloy



Fig. 1. Audcoloy 3×400 etched in 10 per cent. HCl in alcohol. Martensite needles in austenite together with graphite flakes

can be varied to produce alloys with varying characteristics, and with Brinell readings ranging from 100 to 300. Audcoloy 1, which is soft, tough and easily machinable, is made for services requiring only maximum resistance to corrosion. Audcoloy 2 has a higher silicon content and is more suited to guard against erosion with corrosion, and is therefore the grade that finds the widest general application. It is also readily machinable, being a homogeneous material containing no martensite. For withstanding the wearing action of harsh solid particles in suspension, Audcoloy 3 (Fig. 1), a martensitic grade of considerable hardness, has been developed.

Physically the austenitic alloys are weaker than the modern high duty grey cast irons, but this is counterbalanced by the presence of a measurable elongation. Audcoloy has an elongation of up to $3\frac{1}{2}$ per cent. measured on the usual 2 in. gauge length. The tensile strength and elongation vary somewhat with composition, ten tons per square inch being normal, whilst higher strengths are possible under certain conditions. Deflection and compression figures are very good, over 0.5 inch bend on bars up to 2 in. diameter on 18 in. centres being readily obtainable, and compression loads up to 75 tons per square inch being withstood before fracture.

It should be noted that when speaking of softness or low Brinell figures in relation to these alloys, the terms should be used with some reserve, as after an initial "give" all grades show an increased resistance to continued deformation. In fact, the good machinability of most austenitic alloys is due largely to the presence of a certain amount of carbon which is mainly in the graphitic state (Fig. 2).

Records in possession of the Audley Engineering Co. show how their alloy has stood up to tests in the chemical industries. With sulphuric acid, it may be said that, in general, Audcoloy is suitable for use with all strengths of the acid up to 38°C . It is suited to all strengths of caustic soda, cold or hot, especially with the higher concentrations which, when hot, attack cast iron; with fatty acids and mixed acids, too, it has given satisfaction in many instances. In one case, working with fatty acids under extremely difficult conditions, Audcoloy valves lasted eight months as compared with three weeks which was the previous maximum obtained. The material is suitable for general castings with hydrochloric acid up to 15 per cent. and up to 65°C .; naturally lower concentrations can be handled at higher temperatures and higher concentrations at lower temperatures. In general, with this service it is recommended that tests be carried out before recommendations are given. And finally, the alloy is especially good on crude oils, and crude distillates which,

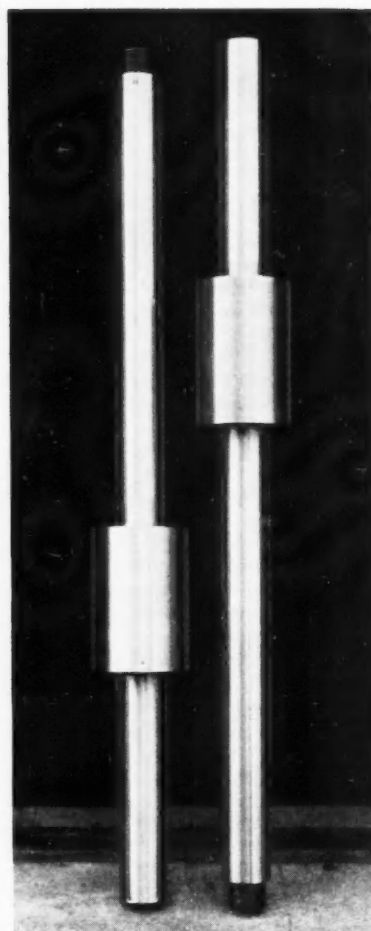


Fig. 3. Audcoloy pump-spindles, showing the silvery machined finish

through the presence of sulphuretted hydrogen, air, etc., readily attack cast iron.

One last point may be made with regard to the appearance of the alloy in service. The accompanying illustration (Fig. 3) of Audcoloy pump spindles gives a good idea of the silvery machined finish.

Black Glass Lamps for Tool-Finishing

A New and Accurate Process

IN the manufacture of tools and gauges, and for bedding in bearings, a very important process is the final finishing, which is usually accomplished by scraping. To detect high spots it has been a common practice to coat the master surface with jeweller's rouge (raddle) or Prussian blue, the uneven places being revealed by particles adhering after the work had been rubbed on to the plate. This method is not particularly satisfactory, because not only may irregularities in coating the master plate with Prussian blue give rise to spurious high spots, but they are also very difficult to discern in normal light.

It has recently been discovered by Mr. H. G. Griffith, B.A., of Aberdeen University, that the process can be accomplished with increased accuracy and speed and without strain to the eyes if the Prussian blue is replaced by a mixture of powdered anthracene in medicinal paraffin oil, and the work inspected under the rays of an Osira black glass lamp. In these circumstances the high spots fluoresce brilliantly enough

to be clearly visible in a normally lighted room, and as the merest trace of anthracene is quite sufficient, this system is more sensitive to detection. After the high spots have been scraped down, the remaining fluorescent materials can again be cleaned off with a rag moistened with benzene in preparation for a second test.

The only apparatus required for this procedure, which has been found materially to speed up production of jigs, is a standard 80-watt or 125-watt Osira black glass lamp and choke with a simple concentrating reflector, together with a few pennyworth of anthracene, which can readily be obtained from any manufacturing chemist or laboratory supplier. The procedure will be found to be equally successful for steel, white metal or brass work.

THE FOLLOWING FERROUS MATERIALS are added to the list of articles and materials the export of which from the United States is prohibited, except under licence, as from December 30: iron ore, pig iron, ferro alloys, ferromanganese, spiegeleisen, ferrosilicon, ferrochrome, ferrotungsten, ferromanganese, ferrocolumbium, ferrocement, ferrophosphorus, ferromolybdenum.

Inventions in the Chemical Industry

The following information is prepared from the Official Patents Journal. Printed copies of Specifications accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.

Applications for Patents

CHEMICAL TREATMENT OF VEGETABLE MATTER.—African Sisal and Produce Co., Ltd., C. L. Walsh, and J. May. 17156.
 MANUFACTURE OF THIAZOLES.—W. R. Boon, and Imperial Chemical Industries, Ltd. 17239.
 PRODUCTION OF SYNTHETIC RUBBER-LIKE COMPOSITIONS.—British Thomson-Houston Co., Ltd. (United States, Dec. 1, '39.) 17037.
 PROCESSES OF PREPARING ESTERS OF methacrylic acid.—British Thomson-Houston Co., Ltd. (United States, Dec. 1, '39.) 17038.
 CONDENSATION PRODUCTS.—British Thomson-Houston Co., Ltd. (United States, Dec. 1, '39.) 17039.
 SYNTHETIC RESINOUS COMPOSITIONS.—British Thomson-Houston Co., Ltd. (United States, Dec. 1, '39.) 17040.
 INSECTICIDES.—A. Burke. 17227.
 PREPARATION OF SULPHONAMIDE DERIVATIVES.—Chinoin Gyogyszeres Vegyeszeti Termek Gyara Reszvenytarsasag. (Hungary, Oct. 12, '39.) 17072.
 PRODUCTION OF AZO DYESTUFFS.—R. B. Collins. 17033.
 MANUFACTURE OF SYNTHETIC RESINS.—E. I. du Pont de Nemours and Co. (United States, Nov. 30, '39.) 17171.
 PRODUCTION OF CAST IRON, and compositions therefor.—Electro Metallurgical Co. (United States, Feb. 6.) 17264; (United States, Feb. 7.) 17265.
 METHOD OF MELTING COPPER.—H. G. C. Fairweather (International Smelting and Refining Co.). 17159.
 MANUFACTURE OF FURAN CARBOXYLIC ACID AMIDES, ETC.—J. R. Geigy, A.-G. (Switzerland, Dec. 2, '39.) 17111.
 RECOVERY OF LIGHT-ALLOY SCRAP.—E. J. Groom. 17073.
 PRODUCTION OF PHOSPHATIC FERTILISERS.—F. W. Harbord and V. Harbord. 17145.
 MANUFACTURE OF LAMINATED FABRICS.—Imperial Chemical Industries, Ltd. (Du Pont de Nemours and Co.). 17044.
 HEAT-TREATMENT OF CAST ALLOY rolling-mill rolls.—H. A. Lomax. 17177.
 DISTILLATION OF SOLID CARBONACEOUS SUBSTANCES.—Low Temperature Carbonisation, Ltd., and J. Cartwright. 17174.
 PRODUCTION OF GLASS SUBSTITUTE.—Lumsden and MacKenzie, Ltd., C. Garrett, and J. A. Addie. 17102.
 PRODUCTION OF TAR BINDERS.—Midland Tar Distillers, Ltd., D. W. Parkes, and R. B. Evans. 17256.
 MANUFACTURE OF REFRACTORIES.—E. A. Pokorny. 17225.
 MANUFACTURE OF ENAMEL-VARNISHED ASBESTOS SHEETS.—M. Seidl. 17229.
 TREATMENT OF PAPER.—O. Singer, H. Stanley, and P. Stanley. 17060.
 SEPARATION OF THORIUM, ETC., from minerals.—F. Soddy. 17015.
 SYNTHESIS OF 2-AMINO-THIAZOLES.—E. R. Squibb and Sons. (United States, Jan. 13.) 17217.
 METHOD OF PRE-TREATING HYDROCARBON OILS.—Standard Oil Development Co. (United States, Dec. 2, '39.) 17139.
 MINERAL OIL COMPOSITIONS.—Standard Oil Development Co. (United States, Dec. 2, '39.) 17139.
 MINERAL OIL COMPOSITIONS.—Standard Oil Development Co. (United States, Jan. 25.) 17140.
 PRODUCTION OF REFRACTORY MATERIAL.—J. G. Stein and Co., Ltd., and J. F. Hyslop. 17121.
 PREPARATION OF STABLE MAGNESIUM ACID CITRATE.—A. H. Stevens (Pfizer and Co.). 17213.
 HALOGENATED POLYMERS OF ETHYLENE.—D. Whittaker and Imperial Chemical Industries, Ltd. 17045.
 PREPARATION OF CHEMICAL COMPOUNDS.—Wingfoot Corporation. (United States, Nov. 29, '39.) 17080.
 METHOD OF TREATING MAGNESIUM.—A. Abbey (Dow Chemical Co.). 17471.
 MANUFACTURE OF ARTIFICIAL RESINOUS CONDENSATION PRODUCTS.—C. J. Brown, and Imperial Chemical Industries, Ltd. 17437.
 MANUFACTURE OF PIGMENTED RESIN.—F. E. Drummond, and W. A. Waldie. 17392.
 MANUFACTURE OF UREA-FORMALDEHYDE RESINOUS COMPOSITIONS.—E. I. du Pont de Nemours and Co. (United States, Dec. 8, '39.) 17361.

Complete Specifications Open to Public Inspection

PROCESS FOR PREPARING BINDING-AGENTS from hydro-dispersions. B. Neuhof. May 20, 1939. 24305/39.
 PROCESS FOR THE PRODUCTION OF NITRILES.—J. R. Geigy, A. G. May 27, 1939. 25243/39.
 PROCESS FOR THE CATALYTIC TREATMENT OF HYDROCARBON OILS.—M. W. Kellogg Co. May 20, 1939. 4629/40.
 VINYL RESIN COMPOSITIONS.—Carbide and Carbon Chemicals Corporation. May 31, 1939. 6903/40.
 CATALYTIC ALKYLATION PROCESS.—Standard Oil Development Co. June 1, 1939. (Cognate Application, 7008/40.) 7007/40.
 PRODUCTION OF SOLID SOLUBLE RUBBER DERIVATIVES.—Honorary Advisory Council for Scientific and Industrial Research. June 2, 1939. 8395/40.

ENAMELS FOR POTTERY which are opaqued by zirconium compounds, and process for preparing same.—Soc. de Produits Chimiques des Terres Rares. May 26, 1939. 8967/40.
 PROCESS OF COLOURING FIBROUS MATERIALS.—I. G. Farbenindustrie. May 27, 1939. 9415/40.
 PROCESS FOR IMPREGNATING TEXTILE MATERIALS.—I. G. Farbenindustrie. May 27, 1939. 9416/40.
 MOISTURE-PROOFING COMPOSITIONS and articles produced therefrom.—British Cellophane, Ltd. June 1, 1939. 9523/40.
 MANUFACTURE OF EFFERVESCENT AMINOARYLSULPHONAMIDE COMPOSITIONS.—Effervescent Products, Inc. June 1, 1939. 9615/40.
 PROCESS FOR THE CATALYTIC POLYMERISATION of normally gaseous olefines.—Universal Oil Products Co. June 15, 1938. (Divided out of 14964/39.) 16983/40.
 PROCESS OF ORE CONCENTRATION BY FLOTATION.—B. Kalinowski. June 5, 1939. 6789/40.
 PROCESS FOR THE CONVERSION OF HYDROCARBON OILS.—Universal Oil Products Co. May 5, 1939. 6872/40.
 METHOD OF CARRYING OUT CATALYTIC REACTIONS, chiefly designed for use in the treatment of hydrocarbon oils.—Standard Oil Development Co. June 3, 1939. 7449/40.
 HEAT-TREATMENT OF ALUMINIUM BASE ALLOYS.—Aluminium Co. of America. May 26, 1939. 8004/40.
 STEEL ALLOYS, and engine parts made therefrom.—Eaton Manufacturing Co. May 6, 1939. 8155/40.
 PLASTIC COMPOSITION.—General Motors Corporation. June 9, 1939. 9051/40.
 METHOD AND DEVICE FOR MANUFACTURING CO. BUTTER from cream and milk.—J. Senn (Cognate Application 9513/40.) May 27, 1939. 9512/40.
 TREATMENT OF TEXTILE MATERIALS.—E. I. du Pont de Nemours and Co. June 5, 1939. 9753/40.

Complete Specifications Accepted

AQUEOUS-OIL EMULSIONS.—W. W. Triggs (Wallerstein Co., Inc.). Feb. 16, 1939. 529,706.
 PREPARATION OF CATALYSTS.—Gas Light and Coke Co., R. H. Griffith, and J. H. G. Plant. Feb. 25, 1939. 529,711.
 BURNING OR HEAT-TREATMENT OF SOLID MATERIALS and the heating of fluid media.—E. A. I. Ormell. April 20, 1939. (Convention date not granted). 529,717.
 PLASTICISING RUBBER SUBSTITUTES.—E. I. du Pont de Nemours and Co. April 26, 1938. (Cognate Applications, 12304/39, 12305/39, and 12306/39.) 529,838.
 SULPHUR POLYMERISED CHLOROPRENE.—E. I. du Pont de Nemours and Co. April 26, 1938. (Cognate Application, 12449/39.) 529,839.
 FORM OF SOAP, and a method of and means for supporting same. B. Fischer. May 20, 1939. 529,731.
 MANUFACTURE OF DIBROMOFLUORANTHENE.—Soc. of Chemical Industry in Basle. May 28, 1938. 529,653.
 SUBSTITUTED PHTHALOCYANINES.—N. H. Haddock and Imperial Chemical Industries, Ltd. May 25, 1939. 529,847.
 PREPARING HIGH MOLECULAR WEIGHT SUBSTITUTED ETHINYL CARBINOLS.—W. J. Tennant (Armour and Co.). May 26, 1939. 529,794.
 CUPROUS CHLORIDE-POTASSIUM CHLORIDE CATALYST for polymerising acetylene to... vinylacetylenes.—E. I. du Pont de Nemours and Co. May 26, 1938. 529,796.
 SYNTHETIC WAX MATERIALS.—E. I. du Pont de Nemours and Co., and C. Dangelmajer. May 26, 1939. (Samples furnished.) 529,797.
 PRODUCING HYDROAROMATIC CYCLOPARAFFINS.—J. G. Fife (N.V. de Bataafsche Petroleum Maatschappij). June 1, 1939. 529,914.
 MANUFACTURE OF RESINS.—Beck, Koller and Co. (England), Ltd. (P. J. Ryan and A. G. Hovey). June 5, 1939. 529,661.
 MANUFACTURE OF CELLULOSE DERIVATIVES.—British Celanese, Ltd. June 7, 1938. 529,688.
 SYNTHETIC RESINOUS COMPOSITIONS, and methods of making the same.—British Thomson-Houston Co., Ltd. June 8, 1938. 529,690.
 EXTRACTION OF CELLULOSE from lignified fibrous material.—W. T. Kerr. June 6, 1939. (Addition to 516,515.) 529,695.
 ELECTRO-DEPOSITION OF NICKEL.—Udylite Corporation. June 15, 1938. 529,825.
 PREPARATION OF NITRILES.—Wingfoot Corporation. Oct. 26, 1938. 529,854.
 REFINING HYDROCARBONS, preferably in the vapour phase, with phosphoric acid.—N.V. de Bataafsche Petroleum Maatschappij. June 21, 1938. 529,873.
 ACYLATED *p*-AMINO BENZYL AMINES, and their quaternary derivatives.—J. R. Geigy, A.-G. June 10, 1938. (Addition to 500,412.) (Cognate Application, 17006/39.) 529,879.
 SILICEOUS BODIES.—N. S. Garbisch. Aug. 11, 1938. 529,930.
 $\phi\phi$ DIHYDROXYDIPHENYL.—Rutgerswerke, A.G. June 22, 1938. 529,936.

New Companies Registered

Texol Cleanser, Limited. (364,512).—Private company. Capital £1000 in 1000 shares of £1 each. Manufacturers of and wholesale and retail dealers in chemicals, disinfectants, compositions, dyes, oils, soaps, etc. Herbert Smith, governing director. Secretary: H. H. Tadman. Registered office: 76 Lowgate, Hull.

Stephen Talbot and Co., Ltd. (364,334).—Private company. Capital: £100 in 100 shares of £1 each. Wholesale and retail chemists and druggists, chemical engineers, sterilisers, dyers, makers of chemical plant and materials, laboratory proprietors, charcoal manufacturers, etc. Directors: Arthur L. Stephens (permanent); Geoffrey H. Rice. Registered office: 388 Uxbridge Road, W.12.

British Melters, Ltd. (364,394).—Private company. Capital: £100 in 100 shares of £1 each. Buying and selling agents, manufacturers, refiners, blenders, melters and preparers of and dealers in fat, tallow, grease, oil, oleaginous and saponaceous substances, feeding meals, fertilisers, bones, gelatine, glue, etc. Subscribers: Stanley H. Lucas; Arthur W. J. Presland. Registered office: 6/9 Surrey Street, W.C.2.

Martin Colour Co., Ltd. (364,476).—Private company. Capital, £4000 in 4000 shares of £1 each. To carry on the business of manufacturers of colours, oxides and materials for the pottery, glass and enamelled iron industries carried on by the Martin Colour Co. at Gate Street, Hanley, Staffs. Subscribers: Wm. H. Hingley, 53 Hall Street, Dudley, Worcs.; Clifford Harrison. Solicitors: Jobson and Marshall, 199 Wolverhampton Street, Dudley. Registered office: Gate Street Mills, Hanley, Staffs.

The Papermakers' Straw Trading Co., Ltd. (364,525).—Private company. Nominal capital £2000 in £1 shares. Purchasers of straw, fibrous materials and other commodities for paper and board producers and others in the United Kingdom (including rags, esparto grass, wood pulp, waste paper, chemicals, dyes, etc.). Directors: Arthur Baker (director, Bowaters Paper Mills, Ltd.); Chas. Snelling, Alastair H. Bruce, James B. Rae, John W. Randall, Arthur C. Reed, J.P., M.P., Alexander E. R. Taylor, Leslie M. Worling. Joint secretaries: F. H. Llewellyn Thomas and Herbert L. Warden. Registered office, Shell-Mex House, Strand, W.C.2.

Company News

Sadler and Co., Ltd., are making a special cash payment of 1s. 3d. per share, free of tax, out of profits on sale of investments.

Fison, Packard and Prentice (Chemicals), Ltd., have maintained their dividend at 10 per cent., by a final distribution of 7½ per cent.

Turner and Newall, Ltd., have declared a final dividend of 11½ per cent. on the ordinary stock, maintaining the distribution at 15 per cent.

William Briggs and Sons (Bitumen Manufacturers, etc.), have declared a final dividend on ordinary shares of 10 per cent., making 12½ per cent. for year (15 per cent.).

Eucryl, Ltd., have maintained the dividend on deferred shares at 15½ per cent. by a final distribution of 10½ per cent. Last year there was also a bonus of 3 per cent.

Chemical and Allied Stocks and Shares

ALTHOUGH the usual January 1 holiday on the Stock Exchange and the heavy air raid on the City affected the volume of business in the stock and share markets, the underlying tendency was firm. British Funds were assisted by the terms of the new Government loans, and subsequently, movements in industrial securities, although small, were inclined to be in favour of holders. Shares of companies associated with the chemical and allied trades were steady and remained firmly held. It may be recalled that during 1940, dividend payments of many leading companies were maintained, including those of Imperial Chemical at 8 per cent. and Turner and Newall at 15 per cent., and on this basis, yields at current prices are quite attractive. Recent results, particularly those of Fison, Packard and Prentice, have indicated the extent to which the high level of taxation can bear on profits. In this case, trading profits for the year to June 30 last were £232,504, which compared with £205,647 in the previous year, but owing to the much larger sum required for taxation, net profits worked out at £65,681, compared with the previous year's £95,505.

The market remains very hopeful that Imperial Chemical will be able to keep its dividend on an 8 per cent. basis. As compared with a week ago, the ordinary units have moved up from 28s. 9d. to 29s. 10½d. at the time of writing; highest and lowest prices in 1940 were 33s. 7½d. and 17s. 9d. respectively. I.C.I. 7 per cent. preference units have remained firm this week at around

33s. 3d. Turner and Newall were 63s. 9d. "ex" the final dividend, while B. Laporte were 52s. 6d. and continued to be held firmly. British Glues 4s. units were quoted at 6s. 3d.; highest and lowest levels in 1940 were 7s. 1½d. and 3s. 6d. During the past year extreme prices for British Oxygen were 78s. 3d. and 42s. 6d., and the current price is 63s. 9d. Only small movements were shown last year in British Drug shares, the extremes being 25s. 3d. and 20s., and the current price is 22s. 6d. On the other hand, Reckitt ordinary's highest and lowest for 1940 were 109s. and 67s. 6d., and the current price is 90s. The 1940 extremes for Cerebos were £9½ and £5½; the present quotation is £8½. Last year Goodlass Wall's highest and lowest were 10s. 7½d. and 5s. 7½d.; these shares are now 9s. 6d. Borax Consolidated deferred units moved between 31s. 3d. and 18s. 1½d. in 1940, and they are now 25s. 7½d. Among smaller-priced securities, General Refractories, now 7s. 6d., had extremes of 9s. 7½d. and 5s. last year.

This week, cement shares were steady, and Associated Cement were 58s. 9d. British Plaster Board were 11s. 9d. Movements in iron and steel securities were small, but Stewarts and Lloyds were firmer at 41s. 6d. and Tube Investments firm at 91s. 6d., while United Steel improved slightly to 21s. 10½d. Apart from Courtalds at 31s. 9d. and British Celanese issues, there was very little activity in textile securities. Elsewhere, Dunlop Rubber were steady at around 32s. 6d., and Distillers were firm at 64s. 9d. Fison Packard at 28s. 9d. were unchanged on balance. Greeff-Chemicals 5s. units continued to be quoted at 5s. 7½d. Wall Paper Manufacturers deferred units displayed steadiness at 21s. 3d.; the highest and lowest levels last year were 26s. 4½d. and 12s. 6d.

Elsewhere, Michael Nairn remained steady at 48s. 9d. awaiting the forthcoming financial results. Boots Drug were 37s. 9d. and Sangers 18s. 6d.xd., while Timothy Whites were 19s. 9d. Oil shares lost part of their recent improvement, but the majority of movements were small on balance.

British Chemical Prices

Chemical Markets

A STEADY tone has prevailed in most sections of the chemical market during the past week and the volume of trade for the period has been fairly satisfactory. Price conditions on the whole are steady, the only change of note being an increase in the current quotations for bichromates, the potash salt crystals being 7d. per lb., and the soda salts being 5½d. per lb. Dealers report a fair interest in new contract business, although in quite a few instances rates have yet to be fixed. Although trade in the market for coal tar products has not been particularly active the general movement has been steady with interest more pronounced than is usual for the period. Values are steady with a firm undertone.

GLASGOW.—The home and export trade in the Scottish heavy chemical industry still remains quiet. Difficulty in getting supplies from the south is retarding prompt delivery and causing inconvenience.

Price Changes

Creosote.—Home trade, 4½d. to 5d. per gal., f.o.r. makers' works, according to grade.

Cresylic Acid.—Pale, 99/100%, 2s. to 2s. 6d. per gal.

Naphtha.—Solvent, 90/160°, 2s. 3d. per gal.

Potassium Bichromate.—Crystals and granular, 7d. per lb.; ground, 7d. per lb.; carriage paid.

Pyridine.—90/180°, 5s. per gal. f.o.b.

Sodium Bichromate.—Crystals, cake and powder, 5½d. per lb., anhydrous, 6d. per lb. net d/d U.K.

Sodium Hyposulphite.—Pea crystals, £17 15s. per ton for 2-ton lots; commercial, £13 10s. per ton; photographic, £17 15s. per ton.

Xylol.—Commercial, 3s. 3d. per gal.; pure, 3s. 6d.

Latest Oil Prices

LONDON.—January 1.—For the period ending February 1 per ton, net, naked, ex mill, works or refinery, and subject to additional charges according to package and location of supplies:—**LINSEED OIL**, raw, £41 10s. **RAPSEED OIL**, crude, £44. **COTTON-SEED OIL**, crude, £31 2s. 6d.; washed, £34 5s.; refined edible, £35 12s. 6d.; refined deodorised, £36 10s. **SOYA BEAN OIL**, crude, £33; refined deodorised, £37. **COCONUT OIL**, crude, £28 2s. 6d.; refined deodorised, £31 7s. 6d. **PALM KERNEL OIL**, crude, £27 10s.; refined deodorised, £30 15s. **PALM OIL**, refined deodorised, £27; refined hardened deodorised £41. **GROUNDNUT OIL**, crude, £35 10s.; refined deodorised, £40. **WHALE OIL**, crude hardened, 42 deg., £30 10s.; refined hardened, 42 deg., £33. **ACID OILS.**—Groundnut, £19; soya, £17; coconut and palm kernel, £22 10s. **ROSIN**, 25s. to 30s. per cwt., ex wharf, according to grade. **TURPENTINE**, 65s. per cwt., spot, American, including tax, ex wharf, in barrels, and ex discount.

HULL.—December 31.—Spot, American, nominal.

